

WHAT IS CLAIMED IS:

1. A storage control apparatus including a plurality of channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; and a cache memory for storing temporarily data to be interchanged between the information processor and the storage device,

the storage control apparatus comprising an internal connector unit for connecting mutually the plurality of channel control units and the disk control unit,

wherein the cache memory is disposed in each of the plurality of channel control units that are connected to one another through a dedicated data transfer path used for storing mutually the data stored in the cache memories.

2. A storage control apparatus including a channel control unit having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; and a first and a second cache memories for storing temporarily data to be interchanged between the information processor and the storage device,

the storage control apparatus comprising an internal connector unit for connecting the channel control unit and the disk control unit to each other,

wherein the first cache memory is disposed in the channel control unit, and the second cache memory is disposed in the

internal connector unit.

3. A storage control apparatus including a plurality of channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; and a first and a second cache memories for storing temporarily data to be interchanged between the information processor and the storage device,

the storage control apparatus comprising an internal connector unit for connecting mutually the plurality of channel control units and the disk control unit,

wherein the first cache memory is disposed in each of the plurality of channel control units that are connected to one another through a dedicated data transfer path used for storing mutually the data stored in the first cache memories, and a couple of the second cache memories for storing mutually the same data are connected to the internal connector unit.

4. A storage system comprising the storage control apparatus and the storage device according to claim 1.

5. A method for writing data to a cache memory by a channel control unit for the case where a data write-in request is issued from an information processor to a storage control apparatus, the storage control apparatus including a plurality of the channel control units each having an interface with the information processor; a disk control unit having an interface

with a storage device for storing data; the cache memory for storing temporarily data to be interchanged between the information processor and the storage device, the cache memory being disposed in each of the plurality of channel control units that are connected to one another through a dedicated data transfer path used for storing mutually the data temporarily stored; and an internal connector unit for connecting mutually the plurality of channel control units and the disk control unit, comprising:

10 receiving data to be written from the information processor;

 writing the data to be written to the cache memory;

 transmitting the data to be written through the dedicated data transfer path to the other channel control unit connected to each other through the dedicated data transfer path;

15 receiving through the dedicated data transfer path an acknowledgement notifying that writing of the transmitted data to the cache memory disposed in the other channel control unit has been completed, from the other channel control unit; and

20 transmitting the acknowledgement notifying that writing to the cache memory of the data to be written has been completed, to the information processor.

6. A method for reading in data stored in a second cache memory to a first cache memory by a channel control unit in a storage control apparatus, the storage control apparatus including a plurality of the channel control units each having an interface

with an information processor; a disk control unit having an interface with a storage device for storing data; the first cache memory for storing temporarily data to be interchanged between the information processor and the storage device, the
5 first cache memory being disposed in each of the plurality of channel control units that are connected to one another through a dedicated data transfer path used for storing mutually the data temporarily stored; a couple of the second cache memories for storing the same data mutually; and an internal connector
10 unit for connecting mutually the plurality of channel control units, the disk control unit and the couple of second cache memories, comprising:

transmitting a read-in command of the data to the second cache memory;

15 acquiring the data from the second cache memory;
writing the acquired data to the first cache memory;
transmitting the acquired data through the dedicated data transfer path to the other channel control unit connected to each other through the dedicated data transfer path; and

20 receiving an acknowledgement notifying that the writing of the transmitted data to the cache memory disposed in the other channel control unit has been completed, from the other channel control unit.

25 7. A method for reading out data by a channel control unit for the case where a data read-out request is issued from an information processor to a storage control apparatus, the

storage control apparatus including a plurality of the channel control units each having an interface with the information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory for storing temporarily data to be interchanged between the information processor and the storage device, the first cache memory being disposed in each of the plurality of channel control units connected to one another through a dedicated data transfer path used for storing mutually the data temporarily stored; a couple of second cache memories for storing the same data mutually; and an internal connector unit for connecting mutually the plurality of channel control units, the disk control unit and the couple of second cache memories, comprising:

receiving from the information processor a read-out command for data for which the address is specified; determining whether the data at the specified address is stored in the first cache memory;

transmitting a read-in command of the data to the second cache memory if the data at the specified address is not stored in the first cache memory;

acquiring the data from the second cache memory; writing the acquired data to the first cache memory; transmitting the acquired data through the dedicated data transfer path to the other channel control unit connected to each other through the dedicated data transfer path; receiving from the other channel control unit an acknowledgement notifying that writing of the transmitted data

to the cache memory disposed in the other channel control unit has been completed; and

transmitting the data to the information processor.

- 5 8. A method for writing out data stored in a first cache memory to a second cache memory by a channel control unit in a storage control apparatus, the storage control apparatus including a plurality of the channel control units each having an interface with an information processor; a disk control unit having an
10 interface with a storage device for storing data; the first cache memory for storing temporarily data to be interchanged between the information processor and the storage device, the first cache memory being disposed in each of the plurality of channel control units connected to one another through a
15 dedicated data transfer path used for storing mutually the data temporarily stored; a couple of the second cache memories for storing the same data mutually; and an internal connector unit for connecting mutually the plurality of channel control units, the disk control unit and the couple of second cache memories,
20 comprising:

selecting the data to be written out to the second cache memory among the data stored in the first cache memory;

securing a storage area to write in the selected data to the second cache memory; and

- 25 transmitting the selected data to the second cache memory.

9. A method for writing out data according to claim 8, wherein

the selection is carried out by selecting data that has not been accessed for the longest period of time.

10. A method for storing by a storage control apparatus into
5 a storage device data stored in a first cache memory and in
a second cache memory for the case where power supply to the
storage control apparatus is interrupted, the storage control
apparatus including a plurality of channel control units each
having an interface with an information processor; a disk control
10 unit having an interface with the storage device for storing
data; the first cache memory for storing temporarily data to
be interchanged between the information processor and the
storage device, the first cache memory being disposed in each
of the plurality of channel control units connected to one another
15 through a dedicated data transfer path used for storing mutually
the data temporarily stored; a couple of the second cache memories
for storing the same data mutually; and an internal connector
unit for connecting mutually the plurality of channel control
units, the disk control unit and the couple of second cache
20 memories, comprising:
switching the power source to a battery provided in advance
in the storage control apparatus;
writing to the second cache memory data stored in the first
cache memory that has been updated by the information processor
25 and that has not yet been written into the second cache memory;
reducing the amount of power supplied from the battery
to the channel control unit after completion of the writing

to the second cache memory;

writing to the storage device data stored in the second cache memory that has been updated by the information processor and that has not yet been written in to the storage device;

5 and

cutting off the supply of power from the battery to the storage control apparatus after completion of the writing to the storage device.

10 11. A channel control unit in a storage control apparatus including a plurality of the channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; and a cache memory for storing temporarily data to be interchanged
15 between the information processor and the storage device, the channel control unit comprising:

an internal connector unit for connecting mutually the cache memory, the plurality of channel control units and the disk control unit, the cache memory being disposed in each of
20 the plurality of channel control units connected to one another through a dedicated data transfer path used for storing mutually the stored data;

a receiver for receiving data to be written from the information processor;

25 a writing portion for writing the data to be written to the cache memory;

a transmitter for transmitting the data to be written

through the dedicated data transfer path to the other channel control unit connected to each other through the dedicated data transfer path;

5 a receiver for receiving from the other channel control unit through the dedicated data transfer path an acknowledgement notifying that the writing of the transmitted data to the cache memory disposed in the other channel control unit has been completed; and

10 a transmitter for transmitting to the information processor the acknowledgement notifying that the writing to the cache memory of the data to be written has been completed.

12. A channel control unit in a storage control apparatus including a plurality of the channel control units each having
15 an interface with the information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory for storing temporarily data to be interchanged between the information processor and the storage device, the first cache memory being disposed in each of the
20 plurality of channel control unit connected to one another by a dedicated data transfer path used for storing mutually the data temporarily stored; a couple of second cache memories for storing the same data mutually; and an internal connector unit for connecting mutually the plurality of channel control units,
25 the disk control unit and the couple of second cache memories, the channel control unit comprising:

a transmitter for transmitting to the second cache memory

a read-in command for data stored in the second cache memory;

an acquiring portion for acquiring the data from the second cache memory;

a writing portion for writing the acquired data to the
5 first cache memory;

a transmitter for transmitting the acquired data through the dedicated data transfer path to the other channel control unit connected to each other through the dedicated data transfer path; and

10 a receiver for receiving from the other channel control unit an acknowledgement notifying that the writing of the transmitted data to the cache memory disposed in the other channel control unit has been completed.

15 13. A channel control unit in a storage control apparatus including a plurality of the channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory for storing temporarily data to be
20 interchanged between the information processor and the storage device, the first cache memory being disposed in each of the plurality of channel control units connected to one another through a dedicated data transfer path used for storing mutually the data temporarily stored; a couple of second cache memories
25 for storing the same data mutually; and an internal connector unit for connecting mutually the plurality of channel control units, the disk control unit and the couple of second cache

memories, the channel control unit comprising:

a receiver for receiving from the information processor
a read-out command for data for which the address is specified;
a determining portion for determining whether the data
5 at the specified address is stored in the first cache memory;
a transmitter for transmitting the read-in command for
the data to the second cache memory if the data at the specified
address is not stored in the first cache memory;
an acquiring portion for acquiring the data from the second
10 cache memory;

a writing portion for writing the acquired data to the
first cache memory;

a transmitter for transmitting the acquired data through
the dedicated data transfer path to the other channel control
15 unit connected to each other through the dedicated data transfer
path;

a receiver for receiving from the other channel control
unit an acknowledgement notifying that the writing of the
transmitted data to the cache memory disposed in the other channel
20 control unit has been completed; and

a transmitter for transmitting the data to the information
processor.

14. A channel control unit in a storage control apparatus
25 including a plurality of the channel control units each having
an interface with an information processor; a disk control unit
having an interface with a storage device for storing data;

a first cache memory for storing temporarily data to be
interchanged between the information processor and the storage
device, the first cache memory being disposed in each of the
plurality of channel control units connected to one another
5 through a dedicated data transfer path used for storing mutually
the data temporarily stored; a couple of second cache memories
for storing the same data mutually; and an internal connector
unit for connecting mutually the plurality of channel control
units, the disk control unit and the couple of second cache
10 memories, the channel control unit comprising:

a selector for selecting the data to be written out to
the second cache memory among data stored in the first cache
memory;

a securing portion for securing a storage area to write
15 in the selected data to the second cache memory; and

a transmitter for transmitting the selected data to the
second cache memory.

15. A channel control unit according to claim 14, wherein the
20 selection is carried out by selecting the data that has not
been accessed for the longest period of time.

16. A storage control apparatus including a plurality of
channel control units each having an interface with an
25 information processor; a disk control unit having an interface
with a storage device for storing data; a first cache memory
for storing temporarily data to be interchanged between the

information processor and the storage device, the first cache memory being disposed in each of the plurality of channel control units connected to one another through a dedicated data transfer path used for storing mutually the data temporarily stored;
5 a couple of second cache memories for storing the same data mutually; and an internal connector unit for connecting mutually the plurality of channel control units, the disk control unit and the second cache memories, the storage control apparatus comprising:

10 a battery for continuously supplying power when supply of power to the storage control apparatus is interrupted;
a switch for switching the power source to the battery when supply of power to the storage control apparatus is interrupted;

15 a writing portion for writing to the second cache memory data stored in the first cache memory that has been updated by the information processor and that has not yet been written in to the second cache memory;

a reducing portion for reducing the supply of power from
20 the battery to the channel control unit after completion of writing to the second cache memory;

a writing portion for writing to the storage device data stored in the second cache memory that has been updated by the information processor and that has not yet been written in to
25 the storage device; and

a cutoff portion for cutting off the supply of power from the battery to the storage control apparatus after completion

of the writing to the storage device.

17. A computer-readable medium containing a computer program
executed on a channel control unit in a storage control apparatus
5 including a plurality of the channel control units each having
an interface with the information processor; a disk control
unit having an interface with a storage device for storing data;
a cache memory for storing temporarily data to be interchanged
between the information processor and the storage device, the
10 cache memory being disposed in each of the plurality of channel
control units connected to one another through a dedicated data
transfer path used for storing mutually the data temporarily
stored; and an internal connector unit for connecting mutually
the plurality of channel control units and the disk control
15 unit, comprising:

receiving data to be written from the information
processor;

writing the data to be written to the cache memory;

transmitting the data to be written through the dedicated
20 data transfer path to the other channel control unit connected
to each other through the dedicated data transfer path;

receiving from the other channel control unit through the
dedicated data transfer path an acknowledgement notifying that
the writing of the transmitted data to the cache memory disposed
25 in the other channel control unit has been completed; and

transmitting to the information processor an
acknowledgement notifying that the writing to the cache memory

of the data to be written has been completed.

18. A computer-readable medium containing a computer program
executed on a channel control unit in a storage control apparatus
5 including a plurality of the channel control units each having
an interface with an information processor; a disk control unit
having an interface with a storage device for storing data;
a first cache memory for storing temporarily data to be
interchanged between the information processor and the storage
10 device, the first cache memory being disposed in each of the
plurality of channel control units connected to one another
through a dedicated data transfer path used for storing mutually
the data temporarily stored; a couple of second cache memories
for storing the same data mutually; and an internal connector
15 unit for connecting mutually the plurality of channel control
units, the disk control unit and the couple of second cache
memories, comprising:

transmitting to the second cache memory a read-in command
for data stored in the second cache memory;
20 acquiring the data from the second cache memory;
writing the acquired data to the first cache memory;
transmitting the acquired data through the dedicated data
transfer path to the other channel control unit connected to
each other through the dedicated data transfer path; and
25 receiving from the other channel control unit an
acknowledgement notifying that the writing of the transmitted
data to the cache memory disposed in the other channel control

unit has been completed.

19. A computer-readable medium containing a computer program executed on a channel control unit in a storage control apparatus
- 5 including a plurality of channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory for storing temporarily data to be interchanged between the information processor and the storage
- 10 device, the first cache memory being disposed in each of the plurality of channel control units connected to one another through a dedicated data transfer path used for storing mutually the data temporarily stored; a couple of second cache memories for storing the same data mutually; and an internal connector
- 15 unit for connecting mutually the plurality of channel control units, the disk control unit and the couple of second cache memories, comprising:
- receiving from the information processor a read-out command for data for which the address is specified;
 - 20 determining whether the data at the specified address is stored in the first cache memory;
 - transmitting a read-in command for the data at the specified address to the first cache memory if the data is not stored in the first cache memory;
 - 25 acquiring the data from the second cache memory;
 - writing the acquired data to the first cache memory;
 - transmitting the acquired data through the dedicated data

transfer path to the other channel control unit connected to each other through the dedicated data transfer path;

receiving from the other channel control unit an acknowledgement notifying that the writing of the transmitted data to the cache memory disposed in the other channel control unit has been completed; and

transmitting the data to the information processor.

20. A computer-readable medium containing a computer program executed on a channel control unit in a storage control apparatus including a plurality of channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory for storing temporarily data to be interchanged between the information processor and the storage device, the first cache memory being disposed in each of the plurality of channel control units connected to one another through a dedicated data transfer path used for storing mutually the data temporarily stored; a couple of second cache memories for storing the same data mutually; and an internal connector unit for connecting mutually the plurality of channel control units, the disk control unit and the couple of second cache memories, comprising:

selecting data to be written out to the second cache memory among data stored in the first cache memory;

securing a storage area to write the selected data to the second cache memory; and

transmitting the selected data to the second cache memory.

21. A computer-readable medium containing a computer program according to claim 20, wherein the selection is carried out
5 by selecting the data that has not been accessed for the longest period of time.

22. A computer-readable medium containing a computer program executed in a storage control apparatus including a plurality
10 of channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory for storing temporarily data to be interchanged between the information processor and the storage device, the first cache
15 memory being disposed in each of the plurality of channel control units connected to one another through a dedicated data transfer path used for storing mutually the data temporarily stored; a couple of second cache memories for storing the same data mutually; and an internal connector unit for connecting mutually
20 the plurality of channel control units, the disk control unit and the couple of second cache memories, comprising:

switching the power source to a battery for continuously supplying power to the storage control apparatus when the supply of power to the storage control apparatus is interrupted;

25 writing to the second cache memory data stored in the first cache memory that has been updated by the information processor and that has not yet been written into the second cache memory;

reducing the amount of power supplied from the battery to the channel control unit after completion of the writing to the second cache memory;

5 writing to the storage device data stored in the second cache memory that has been updated by the information processor and that has not yet been written into the storage device; and

cutting off the supply of power from the battery to the storage control apparatus after completion of the writing to the storage device.